LITHUANIAN ENERGY INSTITUTE
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NATIONAL OPEN ACCESS SCIENTIFIC CENTRE FOR FUTURE ENERGY TECHNOLOGIES

OPEN R & D LITHUANIA

Biogas upgrading – a Lithuanian perspective

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Content

- Lithuanian Energy Institute (LEI) in brief
- Energy and fuel balance of Lithuania in 2017
- Biogas production in Lithuania
- Key barriers to biogas growth
- Perspectives of biogas production
- Funding schemes
- Feedstock potential for biofuels production
- Biogas upgrading

LEI in brief

- **250+** Employees
- **140** researchers
- **25** PhD students
- **11** scientific laboratories
- **12.700** sqm of lab facilities
- **20 MEUR** R&D infrastructure

R&D competencies

RESEARCH ON ENERGY TECHNOLOGIES

- Nuclear and thermonuclear
- RES (wind, biomass)
- H2 energy (fuel cells, storage)
- Combustion and Plasma technologies

THERMAL ENGINEERING & METROLOGY

- Thermal physics
- Gas & Fluid dynamics
- Metrology

ENVIRONMENTAL ENGINEERING

- Hydrology
- Combustion and Plasma technologies
- Environmental impact assessment

MATERIALS SCIENCE

- Materials synthesis
- Materials analysis (surface, bulk)

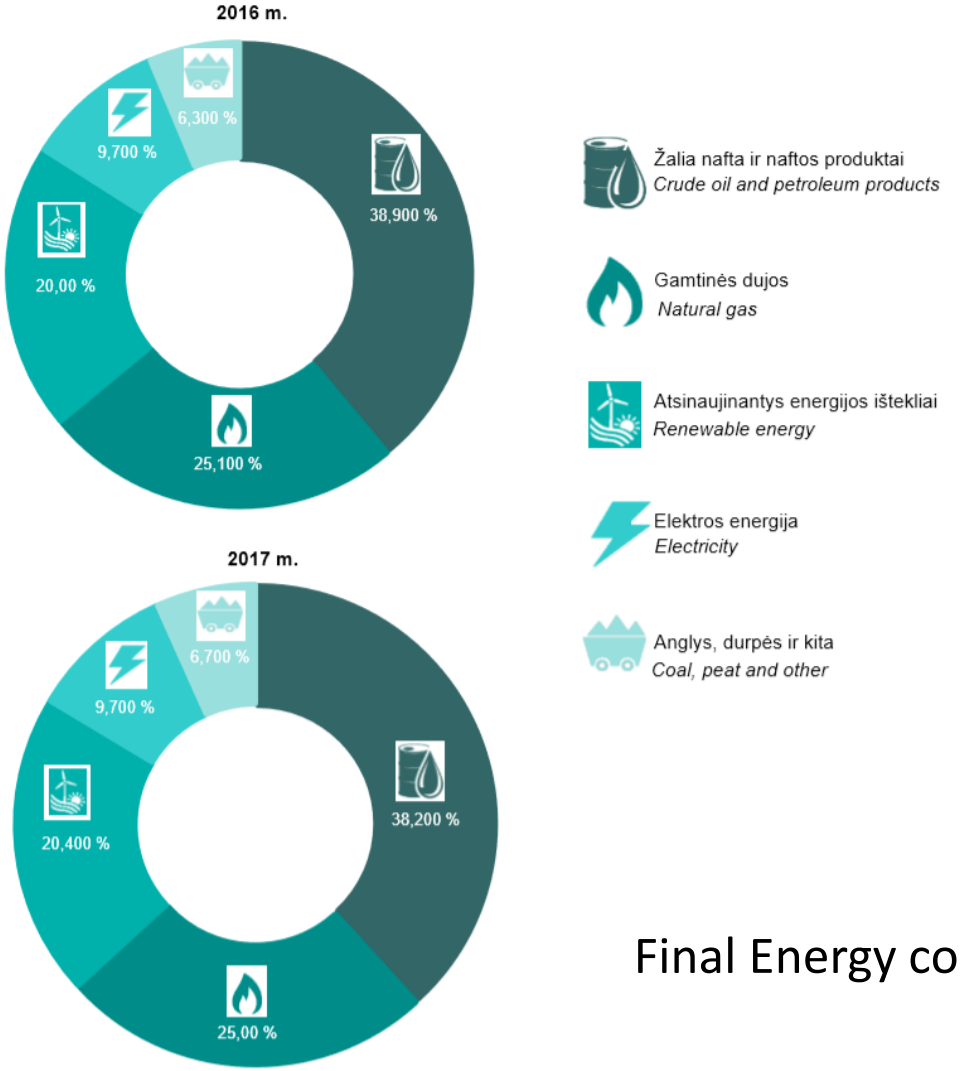
ENERGY SYSTEMS AND ECONOMY

- Energy economy
- Energy systems modeling, smart grids

Energy balance of Lithuania 2017

Procentais
Per cent

Structure of gross inland fuel and energy consumption, 2016–2017



Commitment according to Directive 2009/28/EB on RES
Share of RES 23% by 2020 (**Reached in 2014**)

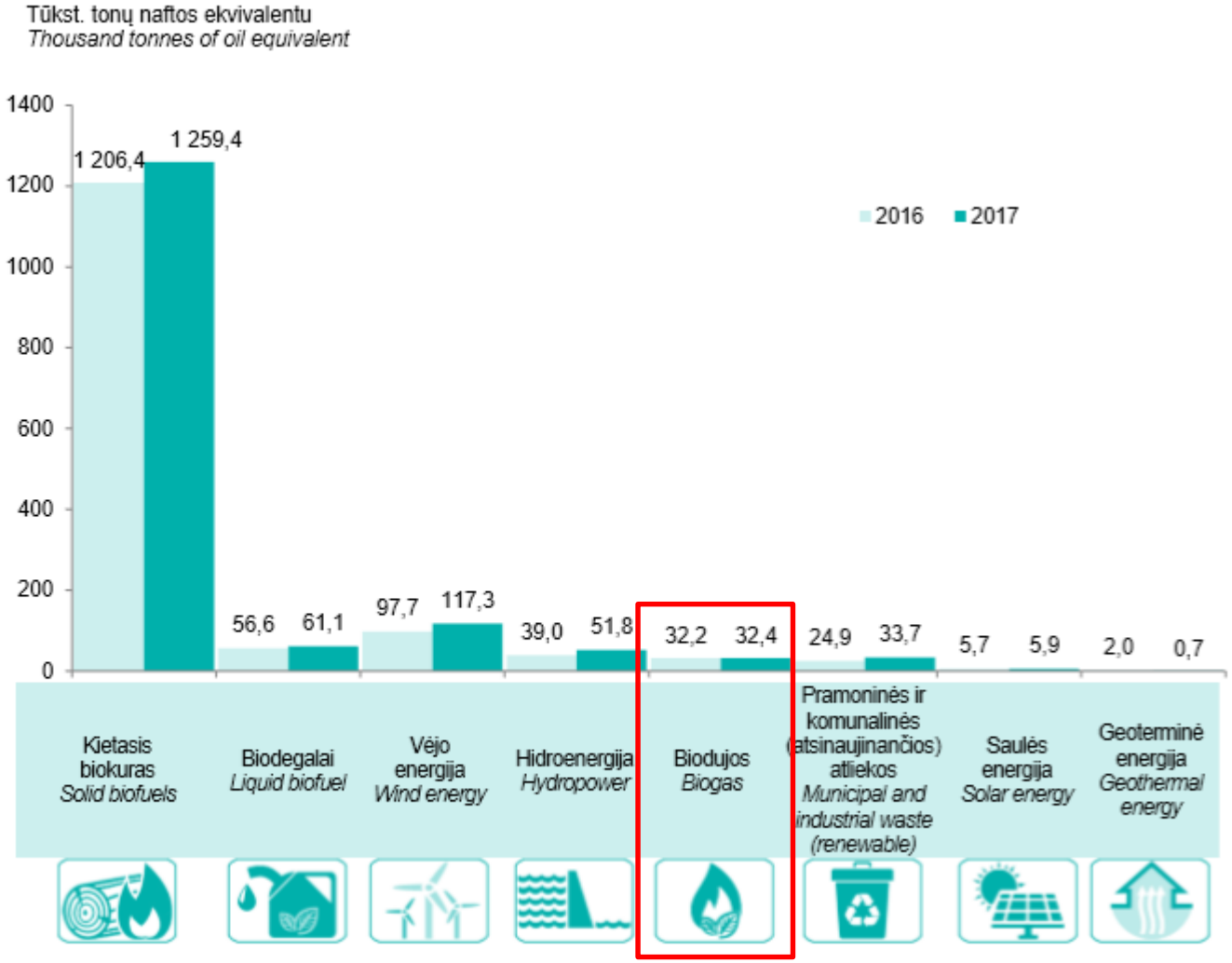
Currently, the share of RES comprises **25,77%** (in 2016)

<u>Targeted goals:</u>
Share of RES **45%** by 2030
Share of RES **80%** by 2050

Final Energy consumption in 2017 exceeded **5348,6** ktoe

Source: Statistics Lithuania, https://osp.stat.gov.lt/services-portlet/pub-edition-file?id=30340

Gross inland consumption of renewable energy



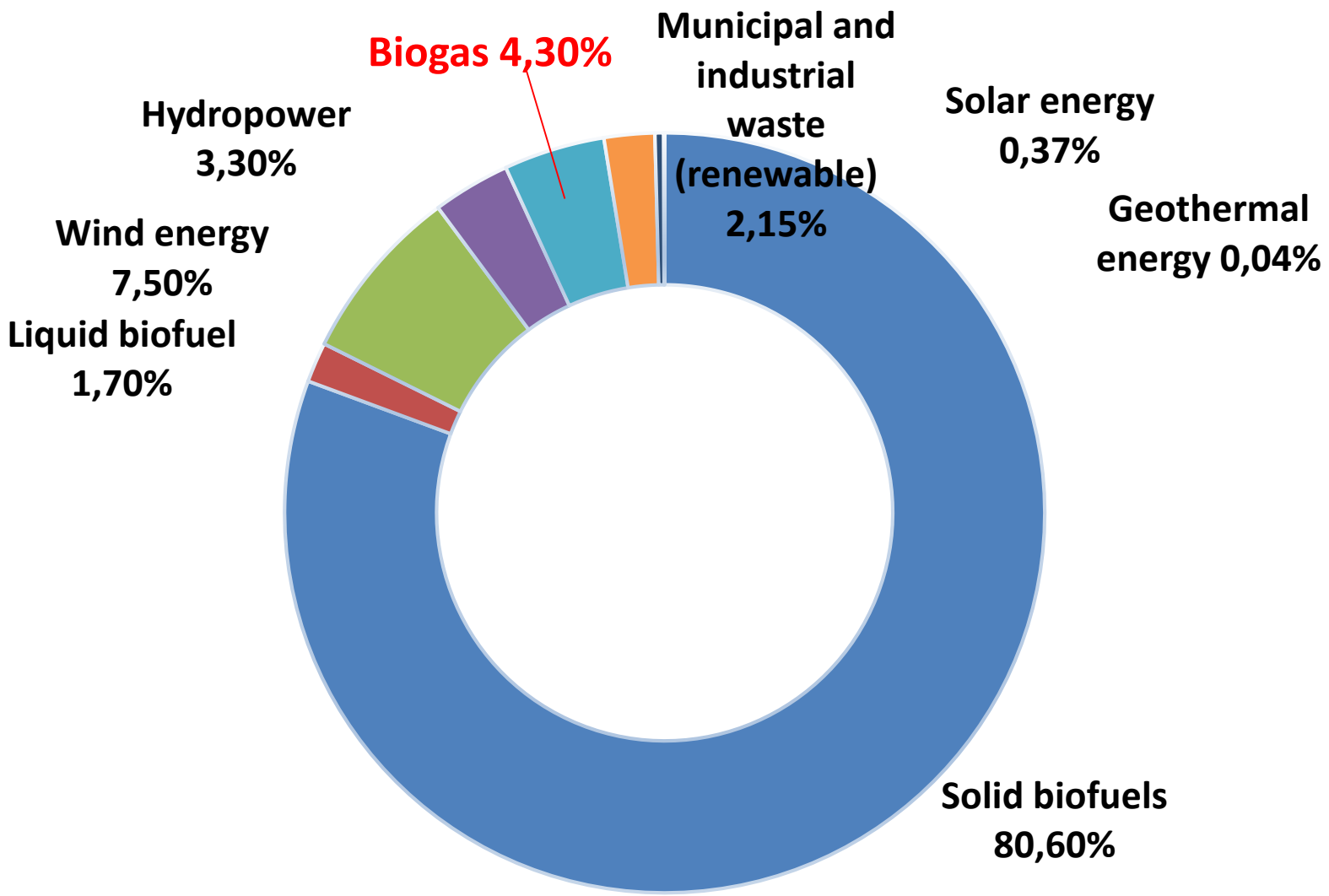
Biogas production from agricultural, landfill and sewage sludge waste in 2016 exceeded **67.6** million m^3.

Annual *natural gas* consumption in Lithuania exceeds around **2.3** billion m^3 (or **24.44** TWh).

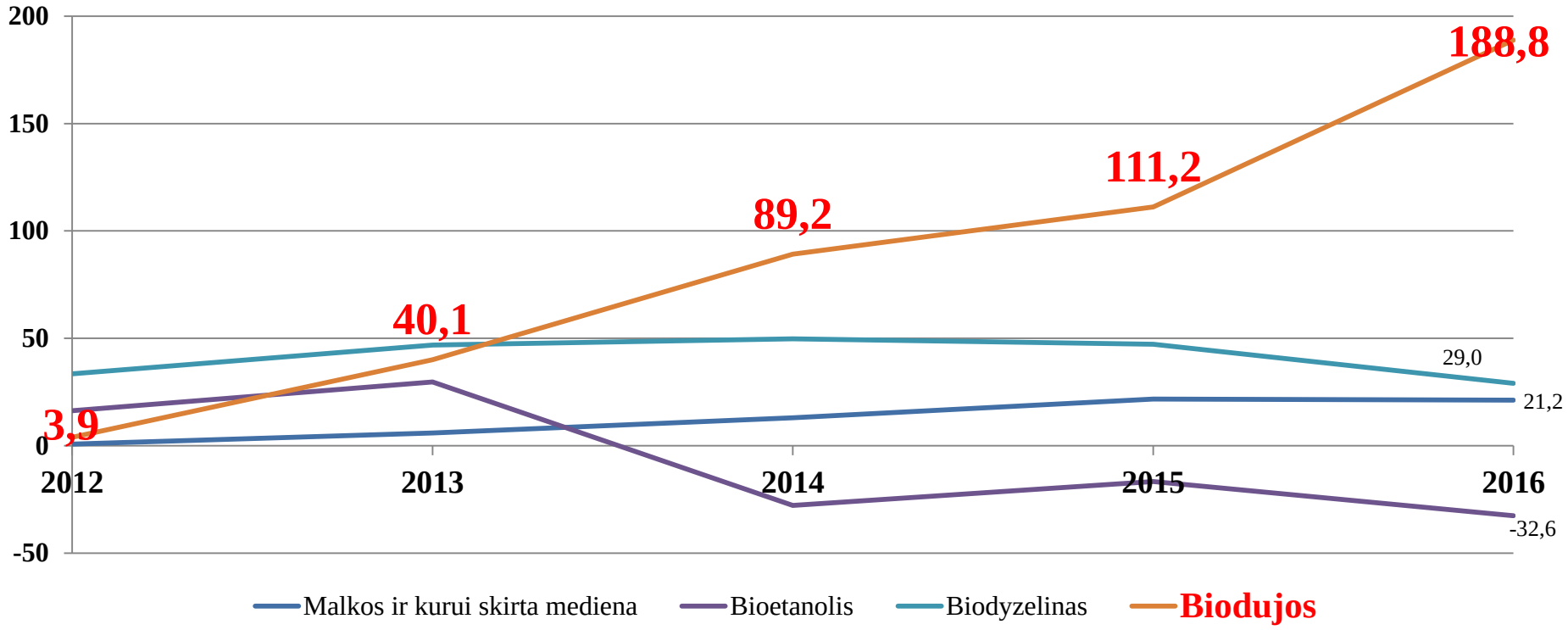
60%	40%
Gazprom	LNG Terminal

Source: Statistics Lithuania, https://osp.stat.gov.lt/services-portlet/pub-edition-file?id=30340

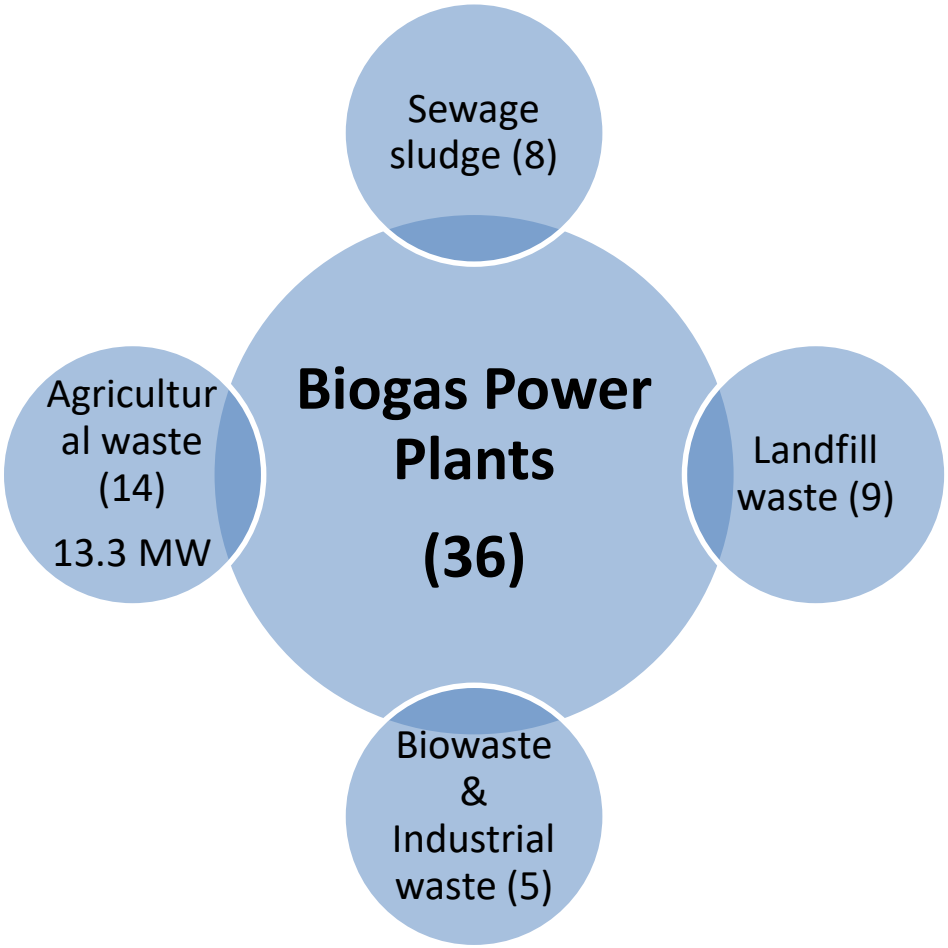
Gross inland consumption of renewable energy in 2017



Production volumes (in%) of the main RES 2012-2016



Biogas production in Lithuania



10 new Biogas plants are being planned to be built in 2016–2020.

Agricultural sector is the main biogas production sector (**61.68%**).

Manure (liquid cattle manure and liquid pig manure) is the main feedstock for biogas production followed by energy crops & organic waste.

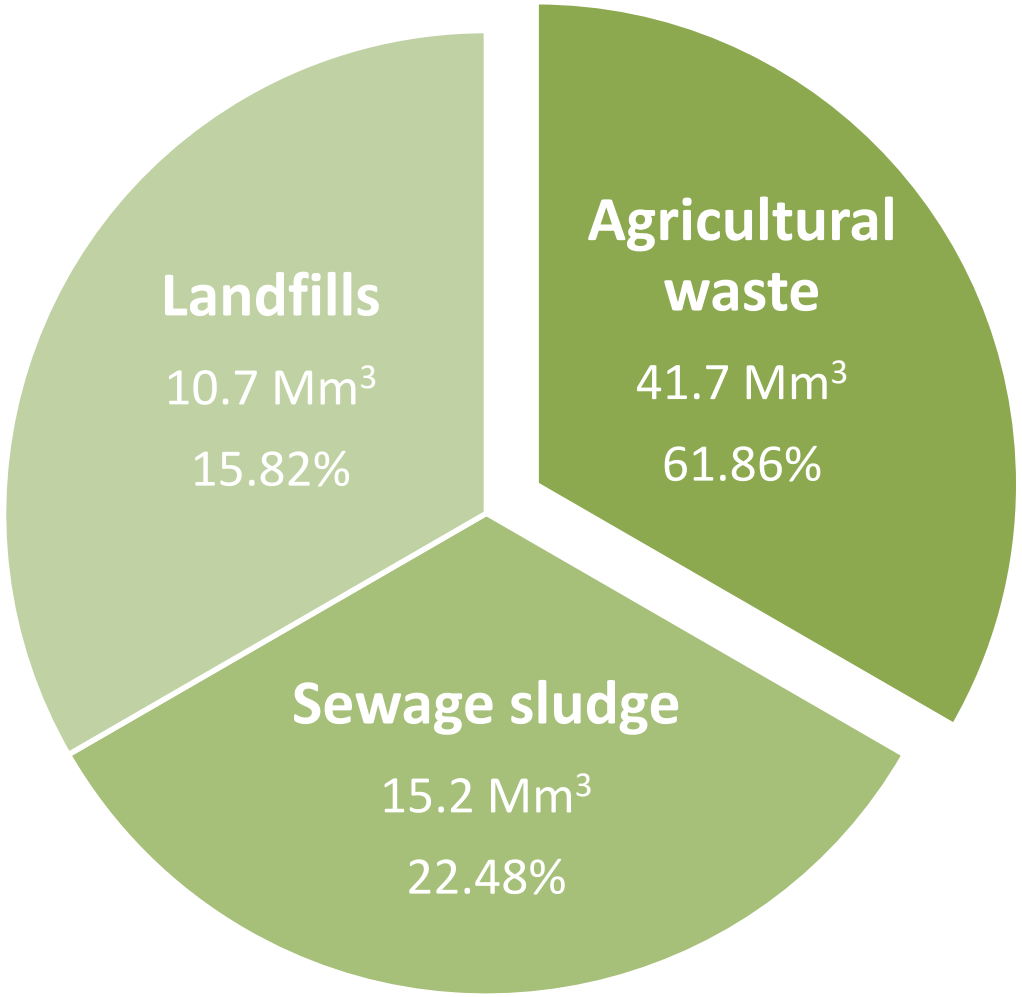
Manure potential: **11** mln. tones/year.

36 power plants capacity:
9.481 MW_{th} & **30.218 MW_{el}**

Biogas usage in transport sector is very limited.

There is no **biomethane** production in Lithuania.

Biogas production in 2017



Source: Statistics Lithuania, https://osp.stat.gov.lt/statistiniu-rodikliu-analize?hash=af9953af-3ff9-4d90-8c92-6335ddc0c012#/

Key barriers to biogas growth
(Agricultural sector)

- Predominance of small farms, **82%**, (cattle breeding or dairy farms). The average farm size does not exceed **12** bovine animals and cows of all ages;

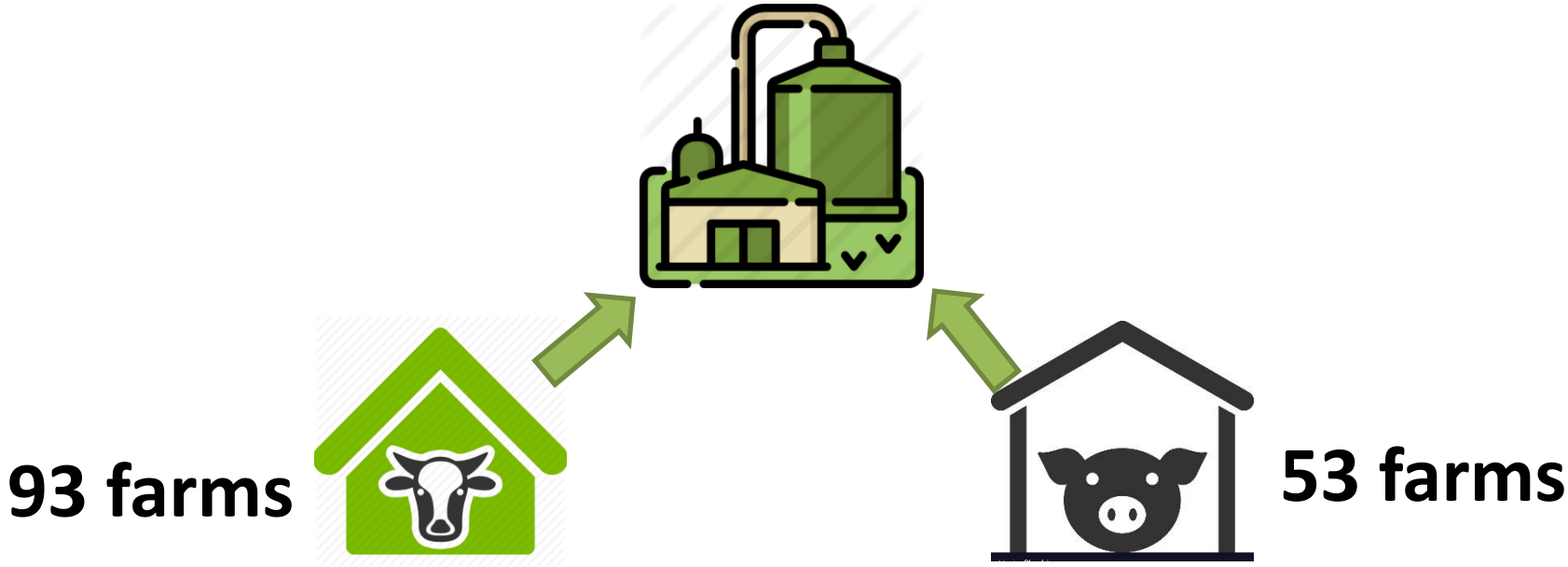
- Uncertainty about the future of livestock farms. Livestock farming is becoming unpopular in agriculture;

- The construction of biogas plants is not sufficiently promoted;

- Lack of knowledge (information, technological, etc.).

Perspectives of Biogas production in Agriculture

- Biogas from agricultural waste extracts 14 power plants, which use only about **2%** animal manure.
- **85%** manure forms on cattle farms, but **no** power plants have been built on these farms.
- Biogas plants could be built on farms with more than **500** cattle and in pig farms where the number of pigs kept is over **1 thousand**.



Perspectives (current situation) of Biogas production in Waste processing

(Landfills, Mechanical-Biological treatment plants)

- Average annual MSW quantity: **1.24** million tones.
- **10** regional waste treatment centres with MBT.
- **4** out of 10 has possibility to produce biogas after biological treatment.
- Currently, biogas production exceeds **2.17** million m^3 per year generating **2** GWh of electricity.
- Total biogas production from Landfills + MBT is **10.7** million m^3.

Source: http://www.ratca.lt/

Perspectives of Biogas production in Sewage Sludge Processing

- Annual quantity of sewage sludge is approx. **50** thousand tones (dry mass)
- **22** sewage sludge treatment plants
- **12** has digestion and drying, others only composting or drying
- Most of biogas is consumed for internal technological process
- Total biogas production from sewage sludge in 2017 was **15.2** million m^3.

Funding schemes for biogas/bioCH4 production

- **Lithuanian Rural Development Programme 2014-2020:**
  - Budget **45 million EUR**;
  - Intensity **60%**.

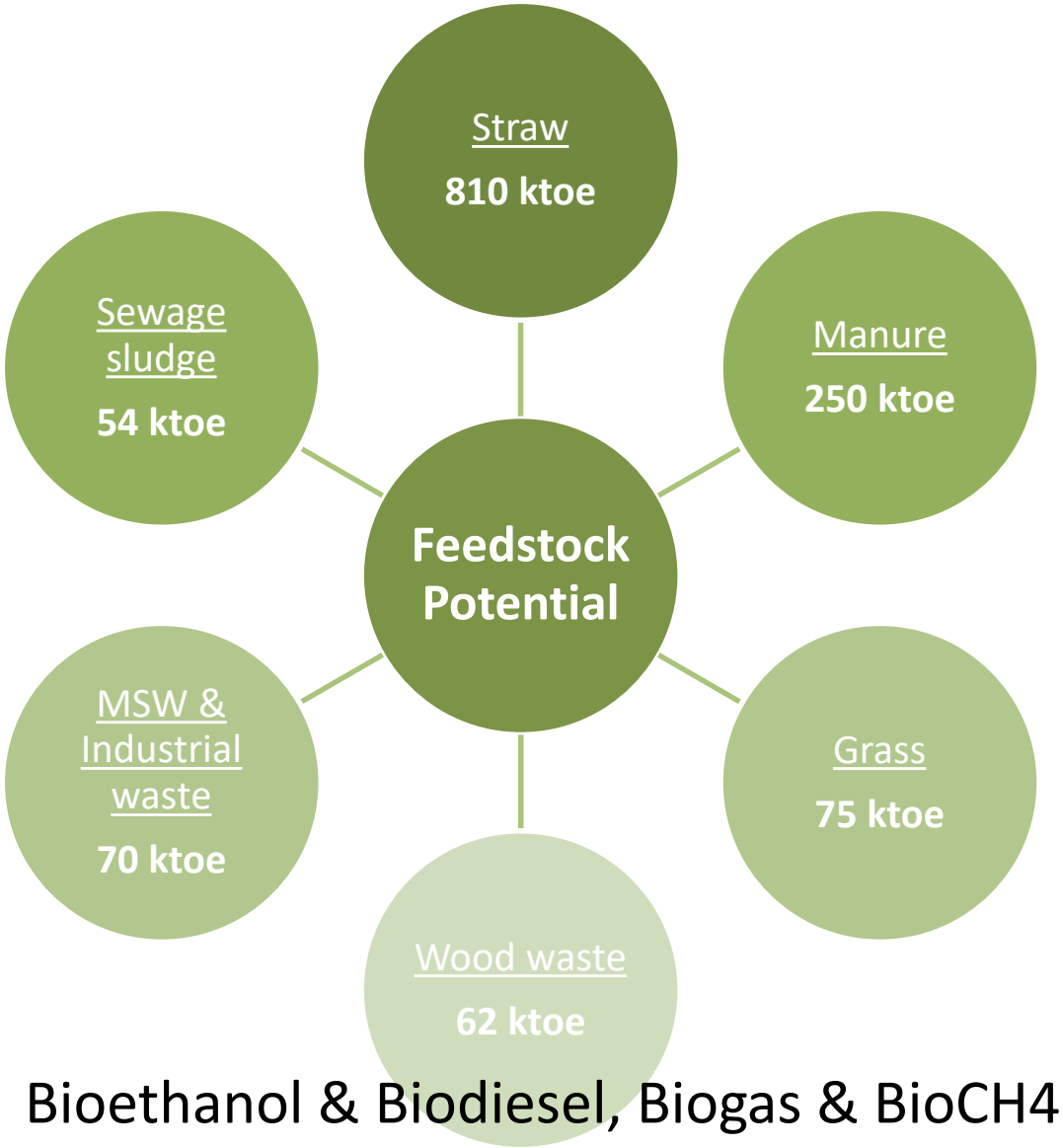
- **Requirements:**
  - At least **50%** of biogas, biomethane or electricity generated from agricultural waste per year will have to be sold;
  - At least **50%** of raw feedstock for biogas production will have to consist of cattle/pig or poultry manure from the farmer's farm, who is the applicant;
  - **0.5 MW** power plant for electricity production.

- **Expectations: 30** new biogas plants with total capacity of **20 MW**.

- **Contradiction**
  - The capacity of 0.5 MW is too powerful for most of the farms;
  - Support is only for a very small or small farms, but such amount of manure can only be ensured on large livestock farms.

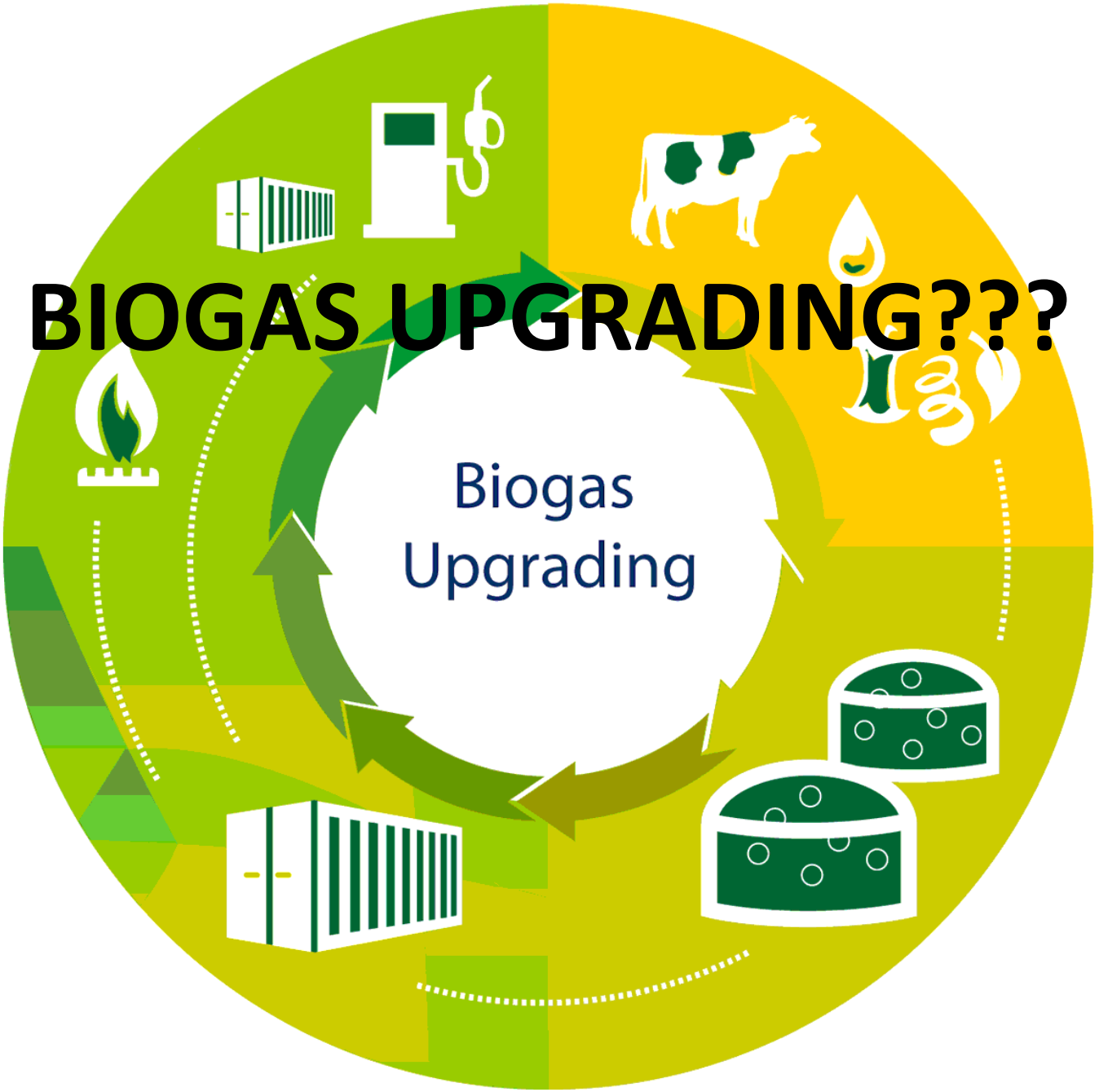
Source: https://zum.lrv.lt/lt/veiklos-sritys/zemes-ir-maisto-ukis/bioenergetika

Feedstock potential for 2nd generation biofuels



Bioethanol & Biodiesel, Biogas & BioCH4

BIOGAS UPGRADING???



“Development of innovative biomethane production technology by applying a catalytic thermochemical conversion”

DOT SUT-228(01.2.2-LMT-K-718-01-0005)

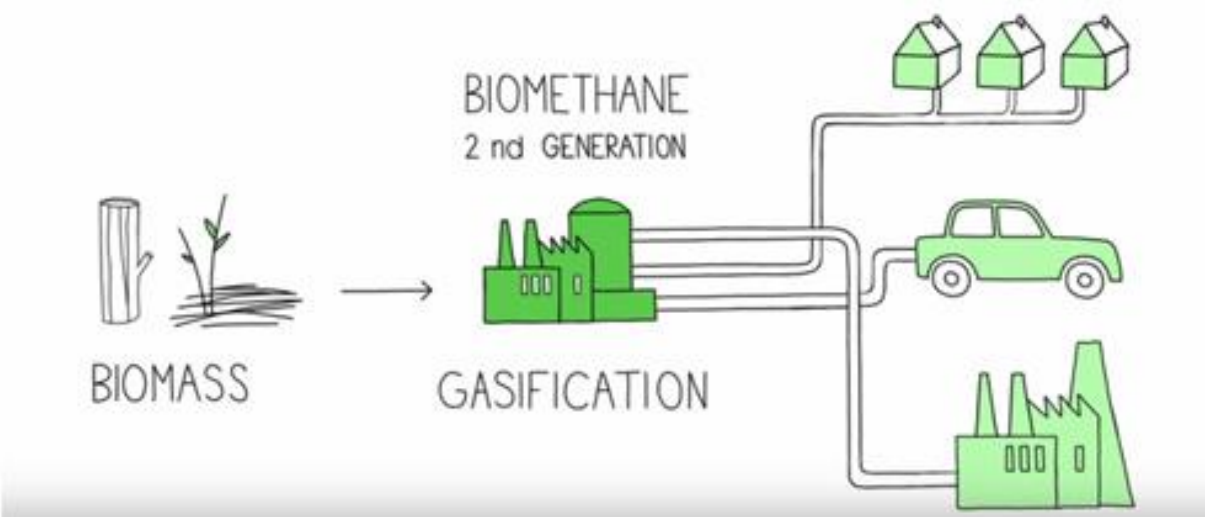
A 4 year project (2018-2021)

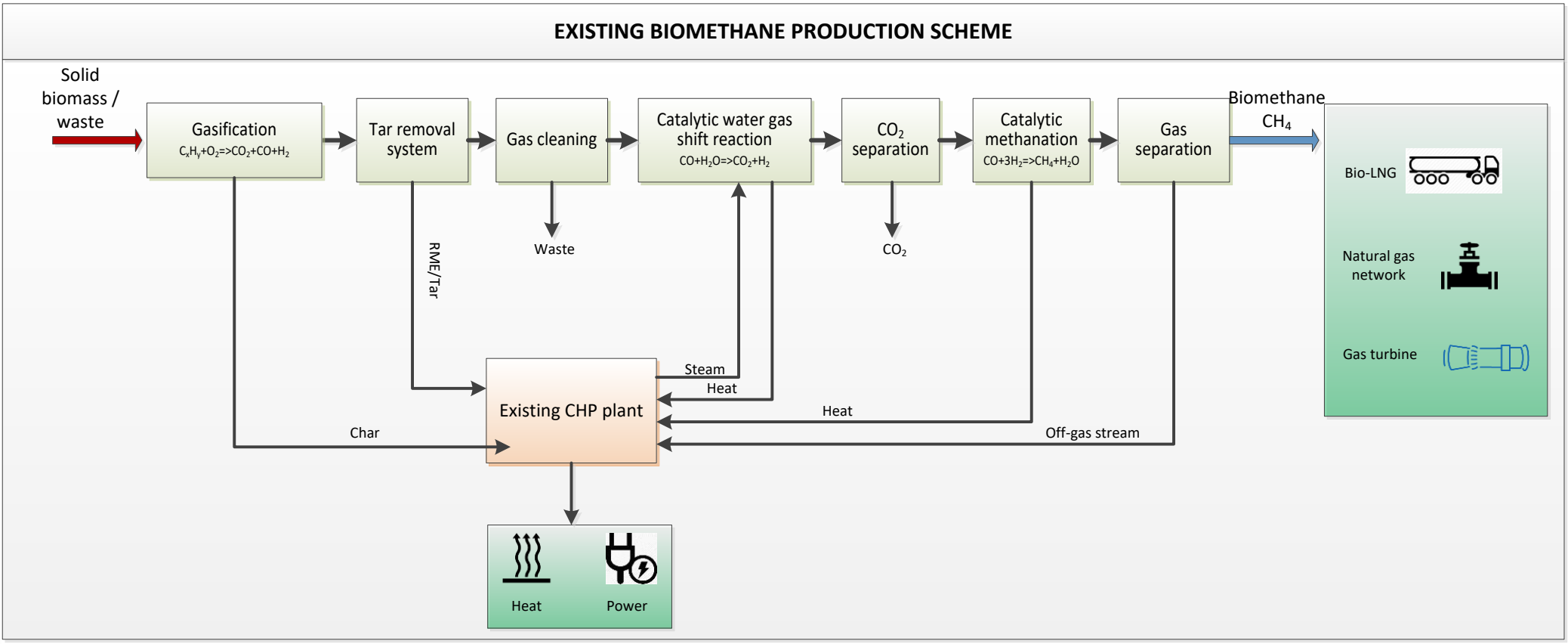
Budget: 654.000 EUR

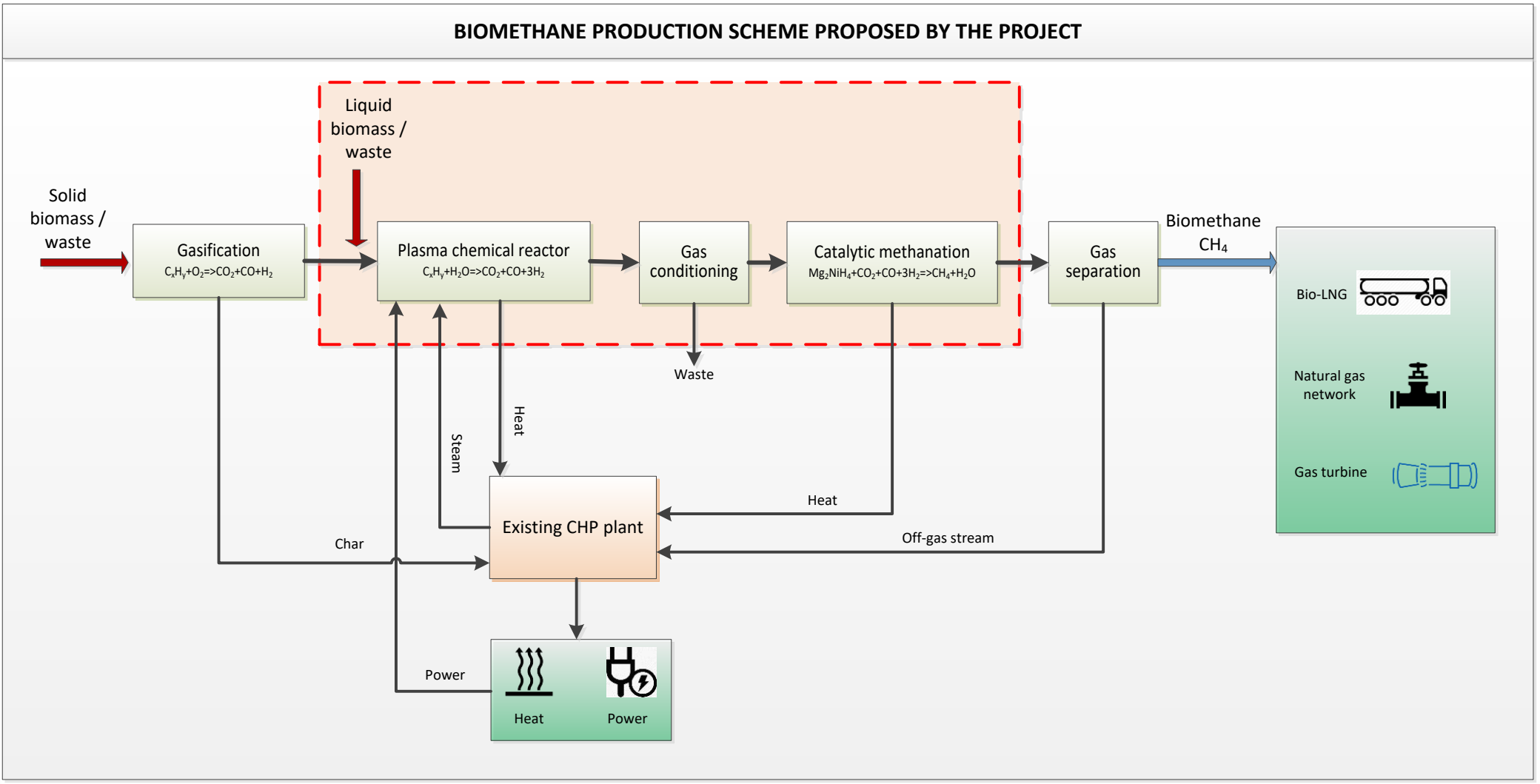
Programme: Lithuanian Innovation Development Programme 2014-2020 (Smart Specialization Strategy)

Priority area: ‘Energy & Sustainable environment’

Priority: ‘Energy & Fuel production using biomass/waste & waste treatment, storage and disposal’




EXISTING BIOMETHANE PRODUCTION SCHEME
Solid biomass / waste
Gasification
$C_xH_y+O_2=>CO_2+CO+H_2$
Tar removal system
Gas cleaning
Catalytic water gas shift reaction
$CO+H_2O=>CO_2+H_2$
CO_2 separation
Catalytic methanation
$CO+3H_2=>CH_4+H_2O$
Gas separation
Biomethane CH_4
Bio-LNG
Natural gas network
Gas turbine
Waste
CO_2
RME/Tar
Steam
Heat
Heat
Char
Off-gas stream
Existing CHP plant
Heat
Power


BIOMETHANE PRODUCTION SCHEME PROPOSED BY THE PROJECT
Liquid biomass / waste
Solid biomass / waste
Gasification
$C_xH_y+O_2=>CO_2+CO+H_2$
Plasma chemical reactor
$C_xH_y+H_2O=>CO_2+CO+3H_2$
Gas conditioning
Catalytic methanation
$Mg_2NiH_4+CO_2+CO+3H_2=>CH_4+H_2O$
Gas separation
Biomethane CH_4
Waste
Steam
Heat
Heat
Char
Existing CHP plant
Off-gas stream
Power
Heat
Power
Bio-LNG
Natural gas network
Gas turbine

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